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CONFERENCES - PAMPHLET BOX - 1924

REPORT

OF

TECHNICAL CONFERENCE

Held under the auspices of

THE RUBBER GROWERS' ASSOCIATION (Inc.)

and

THE RESEARCH ASSOCIATION OF BRITISH RUBBER & TYRE MANUFACTURERS.

IMPERIAL BUREAU OF MYCOLOGY

LONDON.

Friday, 18th July, 1924.

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PREFATORY NOTE.

The Technical Conference, the proceedings of which form the subject matter of this pamphlet, was the outcome of a suggestion that advantage should be taken of the presence in this country of the scientific men from overseas visiting the British Empire Exhibition to arrange a meeting between scientific workers interested in both planting and manufacturing branches of the industry, so that their common problems and difficulties might be discussed. The proposal was widely supported, and under the auspices of the Rubber Growers' Association (Inc.) and The Research Association of British Rubber & Tyre Manufacturers a representative gathering of some 60 technical and scientific men took place at the Great Eastern Hotel, London, on the afternoon of Friday, 18th July.

The Conference, which was preceded by a luncheon, gave rise to a most interesting discussion, and it is hoped that this meeting may be the forerunner of similar meetings as opportunity arises, at which growers and manufacturers may come together to exchange views on matters affecting the welfare and development of the rubber industry as a whole.

The Rubber Growers' Association, Inc.,
2/4, Idol Lane,
Eastcheap, London, E.C.3.

The Research Association of British
Rubber & Tyre Manufacturers,
Laboratories,
105/107, Lansdowne Road, Croydon.

September, 1924.

REPORT OF TECHNICAL CONFERENCE.

Held at the Great Eastern Hotel, London, E.C., on Friday, 18th July, 1924.

The following accepted invitations to the Conference :—

M. Kelway Bamber, F.I.C.,
E. A. Bayles, A.M.I.E.E.,
T. A. Beazley,
C. W. Bickmore,
Noël Bingley,
Prof. V. H. Blackman, M.A., Sc.D., F.R.S.,
Sir Stanley Bois,
A. W. Briggs,
J. H. C. Brooking, M.I.E.E.,
Harold Brown,
P. J. Burgess, M.A., F.C.S.,
E. J. Butler, C.I.E., D.Sc., M.B., F.L.S.,
Lt.-Col. J. Sealy Clarke,
J. S. Corker,
W. S. Davey, B.Sc., A.I.C.,
T. J. Drakeley, Ph.D., M.Sc., F.I.C.,
William Duncan,
Major B. J. Eaton, O.B.E., F.I.C.,
J. Edwardes, M.C., B.Sc., A.I.C.,
F. L. Elliott, F.I.C.,
Prof. J. B. Farmer, M.A., D.Sc., F.R.S.,
J. G. Fol,
William Forsythe,
R. T. Glascodine,
R. W. Griffiths, B.Sc.,
H. C. Harrison,
Ernest Hauser, Ph.D.,
E. M. Hawkins, F.I.C.,
J. G. Hay,
John Healey,
P. V. Hunter, C.B.E., M.I.E.E.,
F. B. Jones, B.Sc.,
S. Jones,
F. Kaye, A.R.C.Sc.,
S. B. Klein,
G. Lever,
R. W. Lunn, M.Sc.,
W. Makower, M.A., D.Sc., F.Inst.P.,
G. Martin, B.Sc., A.I.C.,
H. Eric Miller,
E. D. Money,
S. Morgan, A.R.C.Sc.,
J. A. Nelson, B.Sc.,
S. S. Pickles, D.Sc.,
B. D. Porritt, M.Sc., F.I.C.,
D. A. S. Porteous, A.C.G.I., A.M.I.E.E.,
H. Rogers, F.C.S.,
C. H. Saunders,
H. Savage, M.I.E.E.,
P. Schidrowitz, Ph.D., F.C.S.,
E. B. Skinner,
F. G. Smith,
W. C. Smith, F.C.S.,
H. P. Stevens, M.A., Ph.D., F.I.C.,
Hon. Mr. F. A. Stockdale, M.A., F.L.S.,
J. Traxler,
D. F. Twiss, D.Sc., F.I.C.,
Dr. A. van Rossem,
Prof. G. Stafford Whitby, Ph.D., M.Sc., A.R.C.Sc.,
L. L. Whyte, B.A.,
Sir Henry Wickham, K.B.E.

Chairman:

Mr. H. Eric Miller, Chairman, Rubber Growers' Association.

Vice-Chairman:

Lt.-Col. Sealy Clarke, Vice-Chairman of Research Association of British Rubber & Tyre Manufacturers.

The Chairman: Gentlemen, on behalf of the Rubber Growers' Association and the Research Association of British Rubber & Tyre Manufacturers I desire to extend to you a very hearty welcome. I esteem it a personal privilege to be in the chair on an occasion so auspicious as this. I do not think we have ever had gathered together so much talent in the scientific world connected with the rubber industry, and I hope most sincerely that this gathering will prove to have been so successful that it will be the forerunner of similar regular meetings, which will, I am sure, be most beneficial to the interests of the industry as a whole. (Hear, hear.)

I happen to be on the producing side of the industry, but I can assure you that we as producers do realise that our interests and the interests of the manufacturers and consumers are absolutely wrapped up together, and we do hope that by bringing the various sections of the industry together in this way we will, in the research work which the producers are primarily interested in, get assistance which will guide them in putting their work on the right lines from the point of view of their customers, the manufacturers and the public.

I do not think it is necessary for me to make a long speech; it would be quite out of place. I will therefore call upon Mr. Porritt to read the paper which he has prepared, after which Major Eaton will read his paper, and then Mr. Stockdale will read his, and then we will throw the meeting open for a general discussion. (Applause.)

The following Papers were thereupon read:—

1.—PLANTATION RUBBER FROM THE POINT OF VIEW OF THE MANUFACTURER.

BY

B. D. PORRITT, M.Sc., F.I.C., F.R.S.E.,
Director of Research Association of British Rubber & Tyre Manufacturers.

In opening the discussion this afternoon I should just like, on behalf of my technical colleagues on the manufacturing side of the industry, to endorse the welcome which has been extended by the Chairman in particular to all our friends from the East and Overseas who are present this afternoon. I should also like to express the hope that this meeting may not only mark the beginning of a closer understanding between two branches of a great industry, but, by bringing us into personal contact, afford that fuller appreciation of individual difficulties and needs which, after all, is the fundamental basis of successful co-operation.

As a matter of general principle it is clear that the interests of both branches of the industry have much in common. The future of the Plantation Industry is linked up with the prosperity and development of the manufacture of rubber through which its existing output must be absorbed and its future increases in production disposed of. The manufacturer on the other hand is dependent for his future on adequate supplies of a cheap, clean and uniform raw material. Both parties, I think, are somewhat in the same position as the famous individuals who, when signing the Declaration of Independence, consoled themselves with the reflection that if they did not hang together they would hang separately. I do not propose to dwell on the economic aspects of the stabilisation of the price of rubber, nor to discuss the shortage in a few years time which is so widely predicted in the current American technical press. Should, however, the feat of balancing supply and demand be successfully accomplished I hope those responsible for the future of the estates in the East will not overlook the fact that research and technical development are as necessary in good times as in bad.

Before passing to more technical matters, I might refer to the much criticised Stevenson scheme which, whatever may be its merits or demerits from an economic or political aspect, at least gave full recognition to the important rôle played by science in the prosperity and development of modern industry.

In their first report the Stevenson Committee expressed the view that a substantial proportion of the revenue obtained under a restriction scheme should be specifically set aside and applied for the direct benefit of the Plantation Rubber Industry in such ways as scientific research, and the development of new uses for rubber. As technical men we must hope that this important recommendation may not be overlooked by those responsible for the administration of the funds, and that in years to come the restriction scheme may be remembered not as a temporary expedient to tide over a period of serious economic difficulty, but as the means by which a great industry was permanently placed on a sound scientific basis. (Hear, hear.)

In this connection may I again emphasise my view that in essentials the rubber industry should be regarded as a partnership, and not as two independent units, and that in any scheme of research which may be brought into being the needs of the industry should be viewed in this Imperial spirit. Moreover, in the allocation of any funds, it seems to me that the claims of research and development should be given priority, since spectacular schemes of propaganda and advertisement can be of little avail unless they be based upon the solid foundation of technical efficiency.

Coming to more technical matters, I should like to introduce the points which I have to bring forward for discussion by saying that we at home who have the good fortune to possess every facility for research fully recognise the difficulties under which our colleagues in the East must carry on their work, and the value of the results which have already attended their efforts. Moreover, I need hardly say that any research carried out with the object of ensuring the health of the tree, increasing the yield of latex, or reducing productive costs, is a matter on which the consumer cannot remain indifferent.

Passing over the interesting question of the nature and the cause of the difference between plantation and Para rubber, it seems clear that any improvement in the quality of the estate product has to be sought primarily in the directions of increased cleanliness and uniformity, and in the short time at my disposal I propose to confine my remarks to the former as being the more likely to yield immediate results. Incidentally, however, I would throw out the suggestion that in regard to investigations into the variability and other properties of raw rubber it might be desirable to hold a periodical conference of a number of the scientific workers on both sides to discuss the experimental technique to be employed. This matter might well be considered by the joint technical committee of the two Associations, to the exist-

ence of which we owe the present remarkable gathering of technical men representative of every branch of the rubber industry. Those who are familiar only with the appearance of plantation rubber as it leaves the estates would probably be surprised to see its condition when it reaches the manufacturer. In the place of a reasonably clean product they would find the sheets almost invariably contaminated with dust and wood splinters, which are exceedingly difficult if not impossible in many cases to remove completely, and involve not only extra labour but endless trouble in certain classes of work.

It may be said: Why not wash the rubber? And in reply to this I think I will be on safe ground in saying that a dirty rubber is always dirty, and although some of the grosser impurities may be removed by washing, the general effect of the treatment is to reduce the size of the particles of the extraneous matter and to disseminate them throughout the material. In any case I think this complaint is a matter for prevention rather than cure.

Part of this surface contamination seems due to the method of packing, and part to the conditions under which the material is examined at the Docks, and in any attempt at improvement both these factors should be taken into account. The whole question of the methods adopted for the sampling of rubber is one which seems to need reconsideration in the light of present day conditions.

When wild rubbers of widely varying quality formed the staple supply of the manufacturer, it was clearly necessary to submit deliveries to thorough examination and sampling before any estimate could be formed of their probable value. With the advent of a reasonably uniform and dry product, however, which can be branded to show the source from which it is derived, it seems somewhat difficult to understand what useful purpose can be served by opening the cases to expose the rubber for examination.

I raise the question of the treatment of the rubber at the Docks since it seems to be the first if not the main difficulty which has to be surmounted in any attempt to market the raw material in a superficially clean condition.

Compared with this the protection of the rubber from contamination in transit is probably a relatively simple matter, and a number of materials have already been proposed for completely enclosing the bales. Of these the most promising I think is that of sheets of rubber itself, a suggestion which was put forward about two years ago by the Research Association in the

hope that some definite action would be taken with a view to overcoming the difficulty.

It seems plain, however, that the success of any attempt to introduce cleanly methods of packing must depend upon some drastic revision of the mode of handling the rubber at the docks, and upon the estate itself assuming responsibility for the quality of its output by placing its name on every sheet prepared for export.

In this connection I would draw attention to a recent agreement which will shortly be brought into operation, under which a proportion only of the cases are to be opened for sampling, and although this change is primarily due to considerations of economy it may well represent the first step in solving the problem of dirty rubber.

Apart from the obvious gross mechanical impurities picked up during transit and sampling, it is to be feared that some of the estates themselves do not always fully appreciate the need for scrupulous cleanliness at every stage, from the collection of the latex to the time when the dry rubber is packed for shipment.

Careful examination will often bring to light mechanical impurities actually enclosed in the rubber itself, which though possibly not of serious consequence so far as mechanical goods are concerned, seriously detract from the value of the material for such purposes as the manufacture of polished ebonite. The most obvious of these impurities could no doubt be removed by more careful attention to the straining of the latex, but there is reason to suspect the occasional presence of fine particles of sand in the rubber, due possibly to the water used for washing, or to the intrusion of soil or dust into the latex itself.

That this criticism can be made is probably due to the fact that the manufacturer and the producer have hitherto carried on their work more or less in watertight compartments with the result that the estate manager has devoted his attention to trivial points such as the colour and absence of bubbles in smoked sheet, which seem to be matters of real importance in the opinion of the rubber dealer. The middleman undoubtedly fills an important, and probably indispensible rôle in the industrial system, but this is clearly an economic one, and when technical points arise there can be no question that the producer and consumer must deal with each other direct.

The importance of cleanliness, and the need for a greater degree of uniformity, can be safely left in the hands of subse-

quent speakers, and I will pass on to two matters which may perhaps modify technical practice in the future. At the present time the greater proportion of the output of the estates consists of smoked sheet, and the production of this grade is no doubt a simple matter in an undeveloped country in which plentiful supplies of timber are available. But if we are to judge by the experience of other countries, as time goes on we must be prepared to face the exhaustion of this source of cheap fuel, and unless some bye-product of the estates themselves is found suitable for the purpose, it seems likely that smoked sheet may slowly, but none the less surely, be displaced from its position as a standard product.

A study of the technical press for the past two years suggests that still more radical changes may be in prospect. The confirmation of the claims put forward for the superiority of the rubber prepared by a spray drying process would necessarily open the whole question of the methods to be adopted for the preparation of rubber in the East. The effect might even be more far-reaching.

It has yet to be seen whether the introduction of fillers into the latex prior to evaporation is generally practicable, and if so whether the resultant mixtures are superior to those prepared by the present method. It is clear, however, that any considerable development in this direction, or in the use of latex itself for manufacturing purposes, must profoundly modify technical practice both in the factory and on the estate, and the time may not be far distant when the export of rubber is thought of in terms of volume rather than in terms of weight. Like all other human institutions the rubber industry is subject to the whirligig of time, and after upwards of a century we seem likely to come back to the original proposal that latex should be imported for manufacturing purposes. To illustrate this point I will quote a short passage from an early book on Chemistry, which recently came to my notice, written by the French scientist, Fourcroy, about the year 1790. After describing the effect produced by the addition of hydrochloric acid to rubber latex he goes on to say: *" From these notions I have proposed to import into France the juice of the hevæa, by adding the caustic alkali which prevents the elastic substance from precipitating, in order that we might be able to fabricate all the proper utensils."*

We must, therefore, accept the remarkable fact that over 130 years ago the methods of preserving and coagulating latex were well-known to the scientific men of the day, and that the possibility of importing latex in place of rubber for the manufacture of surgical appliances was clearly recognised.

In conclusion, I feel that any survey of the subject of plantation rubber from the standpoint of the manufacturer would be incomplete without some acknowledgment to the great debt which we owe to the enterprise and optimism of the early pioneers of rubber cultivation in the East.

Thanks to their efforts, not only has technical practice become much simpler with the disappearance of the innumerable varieties and grades of wild rubber, but what is far more important, through the opportune development of a new and rapidly expanding source of supply, the rubber industry was able to meet the demands imposed upon it by the phenomenal development of motor transport.

2.—RESEARCH ON PLANTATION PARA RUBBER.

BY

MAJOR B. J. EATON, O.B.E., F.I.C.,

Government Agricultural Chemist, F.M.S. and S.S.

I want to thank you for the honour you have done me in asking me to read a paper this afternoon. I feel rather shy in front of an audience of this kind—I have for the last 10 or 15 years lectured before planters who are naturally not very cognisant of the technicalities of rubber vulcanisation, and now I have to come before rather a critical audience of manufacturers and scientific officers connected with the manufacturing side of this great industry.

Some ten years ago the principal problem presented to rubber chemists in the East was the variability in the raw product in respect of rate of vulcanization, a problem which I think we may justifiably claim to have solved in Malaya, at any rate in respect of its primary cause and many contributory factors. The knowledge gained as a result of these researches has also enabled us to prepare the raw material in a much more uniform condition.

It is now understood that this problem no longer confronts the manufacturer. The reasons for this are probably the greater uniformity of the plantation product and the increasing use of powerful vulcanization accelerators which obscure and eliminate the natural variability of the raw product.

We who are working in the East and elsewhere in the Tropics, however, would welcome an expression of opinion on this point from the chemists and manufacturers who have to deal with the raw material on this side, since, if the facts are as stated, we can now leave this problem and endeavour to solve others which may be of importance to the rubber manufacturing industry at the present time.

As far as our information goes at present two problems at least are agitating the minds of the manufacturer and his scientific staff, viz., the problem of the most satisfactory method of packing the raw product on the estates and the question of the variability in the milling qualities of the raw material.

Packing.

The first of these problems is not primarily or solely a chemical problem, but one in which members of the producing industry and the manufacturing industry can assist and advise. The producers' point of view may be quite distinct from the manufacturers'.

I suggest, especially in these days of low price of raw rubber, that the producers' principal interest is the packing of his product in the cheapest manner. If cheap packing can be combined with efficient packing, from the point of view of the cleanliness of the raw product when it reaches the market, so much the better.

Unless, however, the producing side of the industry is so organised that any specially recommended type of packing can be insisted on, the individual producer is not likely to make any effort to improve the present condition of affairs, unless he can be assured of obtaining a premium for his product.

I venture to suggest, however, from my experience in Malaya and in the Dutch East Indies, that the time has come for a serious consideration of this problem by all concerned in the benefit of the plantation rubber industry.

At the request of the Chief Secretary of the Federated Malay States, Sir George Maxwell, I completed, just before leaving Malaya, an article, which is being published in the *Malayan Agricultural Journal*, issued monthly by my Department, on the use and misuse of wood in the rubber industry.

Previous to this a special pamphlet published by our Forestry Department was issued on the general problem of the use and misuse of wood in Malaya, and a reference was made in that publication to the use of wood in connection with the smoking of rubber and other uses in estate rubber factories. I do not propose to discuss here the problem of the preparation of the raw material in regard to smoking or other methods of treatment, but would refer those interested to the article in the *Malayan Agricultural Journal*.

I desire, however, to direct attention to the use of wood in the packing of rubber, not from the point of view of the waste of wood, since nearly all packing cases are imported, but from the point of view of the cost of the packing case to the producer and the suitability of cheaper and equally if not more efficient packing cases.

It may interest you to know that two of the largest American rubber manufacturers, who are large producers and buyers in Singapore, export all their rubber in non-wooden packing cases.

The United States Rubber Co., which is also a large producer of the raw product in Sumatra and Malaya, export their product in jute sacking which is specially treated with a rubber solution, while the Firestone Company, which is a large buyer in Singapore, export their product in jute sacking treated with a mixture of tapioca starch and glue. These firms are two of the largest rubber manufacturers in the world.

I suggest that, if the raw product packed in this manner by two of the largest manufacturers in America is satisfactory, there is no reason why all producers should not pack in a similar manner. The cost of such a method of packing is only about one-half that of the wooden packing cases usually employed, and the suitability of the cases from the point of view of the cleanliness of the contents is probably superior to that of wooden cases.

An endeavour is being made in Java by Dr. de Vries and others to encourage the baling of rubber in a similar manner, not only in jute packing, but also in a packing made from the leaves of one of our local palms, *Mengkuang*, similar to the packing used for baling tobacco.

Milling Qualities of Raw Rubber.

I wish here to make only a brief reference to a property of raw rubber which we understand is a source of trouble to rubber manufacturers, viz., the variability in respect of the milling qualities of the raw product. At present I have no information or advice to offer on this problem, since we have not yet tackled the problem in the East, and I refer to it only in order that our manufacturers and their scientific staffs may be able to give us more information on the subject, which may enable us to direct our investigations at the source. There is no doubt in my mind that we have a considerable advantage —of course, we have many disadvantages as well—in the East and in other countries where rubber is grown, in tackling many of these problems, since we know every stage in the history of the raw samples with which we are dealing.

Rubber Solutions.

Another problem in which we understand there is considerable variation in the raw material is that of rubber solutions. A considerable amount of investigation on the variability in viscosity of rubber solutions has been carried out, but the results of these investigations do not appear to have been correlated with the problems with which the manufacturer has to deal, and we should like further information on this problem.

Raw Rubber Preparation in General.

During the last ten to fifteen years there has been no revolutionary change in the method of preparation of the raw material on the estate, and thin pale crepe and smoked sheet still remain the two principal forms in which our raw product appears on the market. There has, of course, been a considerable advance in the preparation of these grades, more especially in respect of an improvement in uniformity.

Whether, however, the cost of producing these grades is justified is, in my opinion, another question. There will, of course, be always a certain demand for pale crepe for specific purposes, but these purposes cannot absorb the large quantities of this grade now produced, which consequently is being utilised for purposes in which its colour or lack of colour is of no real importance. The production of a fine pale crepe to fetch the highest price on the market on account of its appearance is, in my opinion, wasteful from the producers' point of view. (Hear, hear.)

One group of estates in Malaya, until quite recently, has been preparing slab and slab crepe for certain manufacturers in America, while a large rubber manufacturing company in Italy, which owns estates in Malaya and Java, is also preparing all of its crop in a similar manner for use in its own factories in Italy.

I do not mean to suggest here that those particular companies are producing that particular rubber because of special qualities, but because it is more economical from the production point of view.

Presumably the method must have advantages even if it be only that of cost of production.

I should also like to make here a brief mention of the latest method of preparation of the raw product, viz. : the Hopkinson Process, with which you are no doubt all acquainted.

At present, as far as I am aware, the whole of the raw product prepared in this manner is being shipped to the Company's own factories in America. I have no information on the cost of the process in comparison with that of the present market grades—smoked sheet and pale crepe. I am of opinion, however, that a rubber containing all the constituents of the latex, has properties or confers properties on the vulcanised product which are desirable. I think I am correct in saying that Dr. Stevens' investigations tend to show that the vulcanised pro-

duct from this type of rubber has superior ageing qualities, a point which must be of considerable importance, at any rate, to the consumer of the manufactured article.

It may interest you to know that this particular company is now purchasing latex from some thirteen estates in Malaya, apart from manufacturing this type of rubber from its own 50,000 acres in bearing in Sumatra.

Dr. Twiss has recently drawn attention to a "new" property of certain samples of raw rubber, a property which perhaps may be described as "fool-proof." I think I am right in stating that this refers to the fact that some samples of the raw material can be cured or vulcanised over a more prolonged period than others without showing the effect of "overcuring." It may interest Dr. Twiss and the scientific officers of rubber manufacturing firms to know that this property has been known to some of us for some years. I remember discussing it some years ago with my former colleague, Mr. Grantham, who is now with the Holland American Plantation Maatschappij, in Sumatra. I have not carried out any investigations as to the cause, but I believe it to be connected with the non-caoutchouc constituents of the latex or the commercial raw rubber as it appears on the market.

In concluding these brief statements on the preparation of raw rubber for the market in general, I venture to suggest that the period is not far distant when the producer will have to consider other methods of preparation, at any rate as a substitute for smoked sheet, if not on account of economy in preparation or greater suitability of some other form, at least on account of the lack of availability of suitable fuel for smoking purposes.

This I might say is becoming quite a serious problem in Malaya, and I believe one of the latest regulations as far as land is concerned in Malaya, is a regulation in which the Government has some hold over the value of the timber in the virgin jungle before that jungle is allowed to be burned down and planted with rubber.

Uses and Application of Latex.

Coincident with the slump in price of the raw product and possibly on account of this slump, attention has been directed not only to the greater applications and uses of raw rubber, but also to the possible applications and uses of the raw latex.

So far our investigations in the principal rubber producing countries have been directed chiefly to the most suitable methods

of preservation, packing and shipment of the liquid, and also —a problem of primary and fundamental importance—the constitution and variability of the latex.

We have, of course, followed with great interest the work which has been carried out, principally in this country, in which scientific officers appear to be keenly alive to the possibilities of the numerous possible applications and uses of latex, both in connection with new industries or new articles, and also as a substitute for rubber solution in some existing uses.

There remains a large field of work for the chemist and physiologist in the rubber producing countries on problems of this nature in connection with the constitution of the latex and its possible direct treatment in numerous ways for the production of many new articles.

I do not propose to take up any time in referring here to any specific use or application of this wonderful liquid, since many of you are better acquainted with these than I am, and I have not forgotten that I am speaking here before a meeting of scientific officers and critics instead of lecturing before a group of planters who are frequently not well versed in your side of the industry.

I would like, however, in closing, to refer to one of the most recent developments in the treatment of latex which may have an important bearing on the shipment of this product—not forgetting that I have not seen a rubber or technical journal since April, and therefore may be already out of date in the rubber world.

We have here this afternoon with us Dr. Hauser. I am not going to make any special reference to this, but it is quite possible that Dr. Hauser may be able to speak to you later on this particular subject. I refer to concentrated latex or a latex powder which can be prepared by concentrating latex in the presence of certain protective colloids or dispersion agents producing a product resembling milk powders and paste which, on addition of water, can be reconverted to latex and coagulated if required in the ordinary manner. Since, however, this treatment is the subject of patent applications in Malaya I do not propose to deal with it further unless any questions arise out of our discussion, and then I think Dr. Hauser is probably in a much better position than I am to discuss the problem.

In concluding I should like to say that I realise that this paper is of a very attenuated and scrappy nature, and is intended only as a basis of discussion of the numerous problems which we

believe still confront the rubber manufacturer and his scientific staff, and also those of us who have the pleasure or otherwise of working on the producing side in the East.

I sincerely hope that, whatever may be the eventual form of our rubber research organisation in Malaya—personally I hope it will be a combination of the Industry and the Government in Malaya—it will be an organisation in which there will be the closest co-operation and exchange of ideas between the research organisation as representing the producer and the rubber manufacturers in Great Britain. The future of this great industry in our Empire will depend to a very great extent on organisation, co-operation, research and propaganda.

3.—THE CEYLON RUBBER RESEARCH SCHEME.

BY

THE HON. MR. F. A. STOCKDALE, M.A., F.L.S.,

Chairman of the Executive Committee, Ceylon Rubber Research Scheme; Director of Agriculture, Ceylon.

It gives me great pleasure to be here this afternoon, and the short paper which I have prepared details something of the work which has been carried out during the past few years by the Ceylon Rubber Research Scheme.

A detailed account of the work of the Ceylon Rubber Research Scheme was prepared for the International Rubber Exhibition recently held on the Continent. The origin of the first scheme and of its subsequent enlargement in co-operation with the Rubber Growers' Association is well known, and it is, therefore, unnecessary for me to dwell upon the present organisation beyond stating that the work is controlled by an Executive Committee in Ceylon with the assistance of an Advisory Committee in London, while the technical work is carried on in Ceylon and in London under the general supervision of two Technical Committees. The funds of the Scheme are provided by a grant-in-aid from the Government of Ceylon and by subscriptions from the Rubber Growers' Association and from rubber estates and companies in Ceylon. At the present time, slightly over 60 per cent. of the total rubber acreage in Ceylon contributes to the Scheme, or approximately 82 per cent. of the European-owned Estates. Within the past year the number of local subscribers has increased in a very gratifying manner, and it is still hoped that further subscriptions will be secured.

The staff in Ceylon consists at present of an Organising Secretary, a Chemist, a Mycologist, and a Physiological Botanist. The Organising Secretary is responsible for all secretarial duties in Ceylon and for estate inspection. His visits to Estates are principally concerned with questions relating to the methods for controlling diseases, and of dealing with the preparation of rubber. Mr. Mitchell had previously had experience in Malaya, and his visits to estates are greatly appreciated by Estate Superintendents. He brings, during these visits, the work of the

Research Officers of the Scheme to the notice of the Estate management, and in every case submits a full report on his observations on the estate to the Estate's Agents and Superintendent.

The Chemist and the Physiological Botanist have both been permitted to visit Java and the F.M.S. in order to familiarise themselves with rubber research in those countries. The Chemist, Mr. O'Brien, has carried out during the past year an extensive series of experiments with different anti-coagulants for the preservation of latex, and the results of these investigations have been published in bulletin form and distributed to all subscribers. At the present time he is engaged upon an important series of experiments dealing with the smoking of rubber, and has under test various metrolacs or hydrometers of his own manufacture. Much of the smoked sheet of Ceylon is at times affected with rust, and a careful investigation of the cause of this trouble has been made by Mr. O'Brien, in collaboration with Mr. Park, the then Mycologist to the Scheme. This work showed conclusively that " rust " was brought about by the action of micro-organisms, that it develops when surface drying of the sheets is too slow, and when badly ventilated smoke houses are used. As the result of this work there would appear to be no reason why rust in sheet should not be entirely eliminated in the course of a few years. Some work has also been done on mould in sheet rubber, and is being continued.

Mr. Park was attached to the Scheme as Mycologist until the end of last year, and, in addition to work connected with " rust " on sheet rubber, has done useful research work in connection with the use of disinfectants as preventatives for bark rot. The penetration of various disinfectants has been studied in order to ascertain with accuracy their effect on the bark of the tree, and a series of field experiments designed to ascertain the effect of these disinfectants on the causative fungus has been begun. It would appear from the preliminary results already secured that regular applications of preservatives materially reduce the incidence and development of bark rot, but that none of them entirely prevent it. Further work has still to be carried out before any definite statement can be published, and this will be the first work to require the attention of the Scheme's new Mycologist, Mr. Stoughton-Harris. At the present time in Ceylon, the secondary leaf-fall and pod disease is considered to be the most dangerous. Work on this disease is in hand, and a series of manurial trials has been begun in order to ascertain if manuring has any effect upon the incidence of the disease. So far it would appear that manuring may be beneficial in this connection, but it will be necessary to continue the experiments for several years before any recommendations based upon their results can be issued.

The Physiological Botanist, Mr. Taylor, has begun a comprehensive investigation of brown bast, and has had the opportunity of studying work on this disease in Java and Malaya. The exact cause of this disease is still undetermined, but environmental factors in Ceylon have considerable influence upon its incidence. The change-over system of tapping and subsequent bark renewal are being carefully studied. Work is also being done in regard to seed selection and bud-grafting, and the use of cover crops in rubber cultivation is being studied.

The technical staff in London has been enlarged, and now consists of a Superintendent, two Assistant Chemists, and a Mechanic. The principal investigation in progress is a continuation of the study of the variability of plantation rubber. A comparative examination is being made of particular forms of rubber prepared at different times of the year under standard conditions upon different estates selected in representative rubber growing districts of Ceylon. Tests have also been carried out on samples forwarded in connection with experiments dealing with the preservation of latex, and a considerable amount of work is also being done on the examination of rubber prepared by new processes.

The methods of testing rubber have been carefully reconsidered, and certain changes have been made, whilst the possibility of including experiments comparing the behaviour of rubber during the various processes of manufacture is under consideration.

The work of the Scheme is being published in the form of bulletins which are distributed to all subscribers and to members of the Rubber Growers' Association, but, in order to keep subscribing estates in Ceylon in close touch with the work a quarterly circular dealing with the work of the officers of the Scheme and with matters of interest to rubber growers has been begun. The scheme now has a total of 180 members, as against 123 at the end of 1922, and had in hand at the end of last year a balance of Rs. 117,000. It has already built a new laboratory upon Culloden Estate, and two staff bungalows are now being erected. With the proper provision for housing of staff and for their laboratory accommodation several of the difficulties of the research officers will be removed, and a greater output of work may be anticipated.

The work of the Scheme is highly appreciated in Ceylon, and the Tea and Coconut industries are now proposing to establish similar research schemes modelled along lines similar to those of the Rubber Research Scheme.

DISCUSSION.

Dr. Hauser: Mr. Chairman and gentlemen, I have only returned quite recently from Malay, and I did not know that I should have the great honour of saying a few words to you, but as Mr. Eaton was kind enough to ask me to refer to my work, I suppose a point that will interest you in connection with his paper is the question of the concentration of latex. It is a well-known fact that one can concentrate latex up to a certain point without its losing the possibility of being dispersed in water, and if one looks up the patent files on this subject it is extraordinary to find that a far bigger amount of work has been done in this direction than one would have believed; but all this work carried out on concentration of latex has failed at a certain point. It was known that it was possible to concentrate latex to a certain extent, and that it might be possible to bring it down to a cream cheese-like condition by adding certain dispersing substances; but all the processes which have reached this point have one big disadvantage, that the whole amount of rubber in the original latex is never re-obtained in the form of latex. For example, there is an American company working on this problem, which in a private communication a few days ago stated that by bringing the latex down to about 20 per cent. water content, there is already a loss of about 10 per cent. of irreversible material. It has been possible by other ways which are disclosed in different patent applications, one of which has been published recently in Great Britain, to bring down the liquid latex to any concentration wished. You can bring it down to a paste-like condition, like frozen butter, or cream cheese; and not only that, but you can even reach a point where the product is absolutely water-free, containing no moisture at all and similar to milk powder. It is to be hoped that those processes will be developed, and we are proud that it is an English company that is investigating it and trying to put it forward as a commercial scheme.

I may mention that fairly big shipments of this product have been made for some time from Malay. If one mentions that protective colloids can give the desired results, it may seem that the whole process is comparatively simple, and it must be wondered why more people have not thought about doing it. I personally believe the reason why previous work in this direction has been an absolute failure is due to the extraordinary nature of the colloidal chemistry of latex. It is, I believe, the most difficult colloidal system existing. Not every protective colloid will be of use in dealing with latex; on the contrary, some protective colloids which protect other substances are of no value at all in latex research. This is due to the extraordinary behaviour of latex.

When in Malacca I read a paper on Latex Research, and I am told that it has been published in part in this country in the *India Rubber Journal*. I do not want to go further into details, as my time is limited now, but I would like to draw the attention of all those interested in the subject to a paper I will be publishing in a short time, when I have had time to go through all my results and figures, obtained during my four months' stay in Malacca. (Applause.)

Dr. Twiss: I feel in a false position in coming forward. It is of historical interest, however, to mention that years ago, certain samples of a special form of rubber in which the Dunlop Rubber Company was interested showed unusual features, and so led Major Eaton to begin his investigations into the variability of plantation rubber with respect to rate of vulcanisation. Vulcanisation variability, however, is not now such a serious source of trouble to manufacturers as it was earlier, although a complete remedy for the variation in that respect is still much to be desired. Other features of variability, however, are to-day pressing for attention, particularly those with reference to foreign matter and hardness; the latter term indeed may involve more than one important factor, e.g., plasticity and ease of flow or extrusion. Variation in these may be more serious in manufacturing practice than the present degree of variability in rate of vulcanisation.

Perhaps the most important point raised in the opening remarks was that as to the form in which rubber will be used in the future. Each of the present standard forms possesses its own advantages. Smoked sheet frequently shows a marked degree of softness in the factory; the quality of crepe rubber can to some extent be judged by the colour. If plantation rubber of more uniform appearance were to be placed on the market it might become difficult to select lots suitable for special purposes. The difficulty could be solved if the name of the plantation, and possibly the quality, were marked on the rubber itself, whether sheeted or creped. The only other point I would like to mention is with respect to Major Eaton's reference to a "fool-proof" feature of some rubbers as this may have led to a wrong impression. Apart from varying in rate of vulcanisation, rubber varies in the range over which vulcanisation produces satisfactory mechanical properties. Some rubbers develop the desired mechanical features at an earlier stage of vulcanisation than others, thus giving the possibility of a satisfactory product with a lower degree of vulcanisation and enhanced ageing properties. The important advantage offered by such rubber is not so much the possibility of over-vulcanisation as the possibility of relative

under-vulcanisation and the consequent improvement of the manufactured article in resistance to deterioration with the passage of time.

Dr. Van Rossem: Mr. Chairman, before discussing a few points in regard to the papers which have been read, I want to thank you, on behalf of Mr. Fol and myself, for your invitation to come to this most interesting meeting. I would like to make the following remarks.

In the first place, there is the question of the packing of the plantation rubber. I think we are all aware that there ought to be a great change in that respect, and in regard to the question, "How?" I should like to point out that I think the elimination of dirt and nails, etc., in the rubber would not be too difficult if the rubber was properly wrapped in sheets or in crepe. I have seen several plantation packages carried out in this way on the Amsterdam market, and they were in very good condition in respect to cleanliness. Also, I think what Mr. Eaton told us about the methods of packing in the American plantation factories is worth considering.

The second point in regard to packing plantation rubber is the behaviour of bales in transit. I cannot quite judge the effect, but I should think there is a possibility that the rubber would pack very closely and the whole consignment would arrive in solid blocks, especially under conditions of higher temperature during the voyage. I have had several samples of rubber packed in these bales, and some of them were quite pressed into blocks. I should think this is a difficulty which could easily be overcome by big manufacturers, as they have big cutting machines, but it would perhaps be a real difficulty for the smaller manufacturers, and this is a point which would have to be considered.

Another point to which I would like to refer is the milling properties of the rubber. I quite agree with Mr. Porritt and Mr. Eaton that this question is of much importance, but in this respect I should like to see some effort in co-operation. I would like to have co-operation especially in the direction of devising some standard or measure of milling properties (consumption of power on masticating the rubber). I think the manufacturers feel the need of this, but I do not think there is any reliable method of measuring this property. When a sample is considered from the point of view of the manufacturer, there should be a method of measuring milling capacity in the material. We more or less lack such a method, and I should like the discussion on this point to take us further.

There is still one point I would like to mention. One of the speakers has referred to " fool-proof " rubber and the experiments of Dr. Twiss. The characteristic of such material is called, I think, the " Plateau " effect. I may say that ageing qualities are also important, and I should like to link these two points together. I have an opinion, though at the moment I cannot state it as a result of experiment, that these two properties are related. I should think it probable that rubbers which have a strong " Plateau " effect have also good ageing qualities.

It is my conviction that it will be possible to ensure good milling properties in a simple way. We all know there are several accelerators which soften the rubber considerably. If you were to mix such accelerators in moderate quantity into the latex —for example, by the spraying process and perhaps before coagulation—I suppose that you would get a rubber which would mill very easily.

In regard to latex I should like to mention only a few points. The statement of Dr. Hauser is certainly of great interest. We all know if we have to ship ordinary latex the freight will be too high, and to get over this we must concentrate the latex. But the ideal of concentration is that the rubber shall be retained in the reversible form, i.e., a rubber which one can re-dissolve in water to a latex. As far as I have understood Dr. Hauser, he has invented a method that meets those requirements, and I consider it a matter of the greatest importance. In regard to mixing the latex with compounding ingredients, I should not anticipate this becoming a regular practice on the plantations. It is different when a manufacturer has his own plantation and can send over to his factories the mixes he wants, but when the rubber is prepared to be sent on to the market I do not consider it would be very useful to put in any of the compounding ingredients, since every manufacturer likes his own mixings, and it will be a long time before these mixings are standardised. The latex will have to be sent in such a way that each manufacturer can put in compounding ingredients, according to his special requirements.

I think these are the matters I wanted to raise. But there is one general point. I would express the hope that this conference will be the beginning of the co-operation of producers and manufacturers on both sides, and especially in standardisation of methods and research in the rubber industry.

Dr. P. Schidrowitz: Mr. Chairman, I thank you very much for kindly inviting me here to-day. This gathering is of particular interest to me because I remember as far back as the

Exhibition of 1908, there were various conferences of manufacturers and producers, the idea being to bring them together. But I must say, looking back to that time, that the manufacturers and the producers at that day were in essentials at sixes and sevens. I do not think there was any cordial desire among them to get together; they rather looked on each other as antagonists. A gathering such as we have here to-day seems to me to mark the beginning of a new epoch, or rather to hall-mark the new spirit which has arisen of late. Since the Associations represented here to-day have got into real contact, the difficulties no longer appear incapable of solution, and I think we are really getting to see that what we have been dimly striving for in the past is to-day capable of realisation.

The Chairman has asked me to follow on the remarks of Dr. Hauser. I have paid some little attention to matters connected with latex. Adverting to a remark of Dr. Van Rossem about the cost of transport, I admit that it is undoubtedly high, but can say quite positively that for some purposes that is not really a matter of importance. For other purposes, however, it is an important consideration, and here we hope that the methods Dr. Hauser has worked out will come into use, and thus enable us to give the manufacturer in this country and elsewhere rubber in dry powder or some other concentrated form, capable of being re-transformed, without loss, into latex. I think it is going to take some little time before manufacturers will appreciate it, but I think they will gradually come to the conclusion that it is a very important development indeed. There are certain compounding ingredients, now difficult to use, which can be put into latex with ease, and in this way you can achieve results which are impossible to obtain by ordinary methods. That is only one of the applications of this development, but there are a number of others. The question as to whether anything of this sort is going to be done on a large scale is obviously largely a question of cost. Cost means either a cheaper or a better product, and I venture to think that when this subject has been properly thrashed out, and when the manufacturer appreciates what it is, he will come to the conclusion that it is worth his attention. I may be crying in the wilderness. I did so ten years ago in similar matters, and again I am willing to wait the results that I believe will follow.

There is one other point which has been referred to by various speakers, and that is the further standardisation of rubber, particularly as regards plasticity or milling qualities. I had the honour some few months ago to read a paper before the Birmingham Section of the Institution of the Rubber Industry, and I had a formidable audience, consisting largely of experts. I was deal-

ing with physical methods of testing and the physical properties of rubber, and it is significant that about 75 per cent. of the discussion centred round this very point. This shows that the point is regarded as very important. With regard to the methods of measuring plasticity, I venture to think we have at our disposal two classes of methods which work very well. One was described by me in a patent about ten years ago. This consists in measuring the power consumption over a short unit of time. The other, which is coming into favour, is an extrusion method—taking a small sample, forcing it through a die, and seeing what power or time is required to force a quantity of rubber through, or *vice versa*. These methods are quite accurate enough for work, even on a small scale.

Dr. S. S. Pickles: I hardly expected to be called upon to speak this afternoon, and I have not prepared anything, so I shall have to give you just a few of the ideas which rise to the mind of a technical man when he hears some of these subjects mentioned.

First of all, there is this question of packing the rubber. I think we have all in the past had a certain amount of difficulty on this account. The question of packing has been with us right away from the old days of the wild rubbers. In those days bits of sacking and the like did not matter very much. But when we had a plantation product more or less pure otherwise we began to notice the small things and cry out about them. First of all, there are the boxes. In many cases the boxes that arrive at the manufacturers' works are smashed about in a way that we cannot blame the plantation people for. They are opened at the docks, and sometimes in a single case you will find four or five different plantation marks. (Laughter.) These things do happen sometimes. This, however, could be got over to a certain extent if we could only get a guarantee that the rubber is a standard grade from one plantation and the cases have not been opened. There is another question connected with packing, and that is that during the process of packing the rubber and before it is put into the boxes it is, I understand, moderately warmed and then submitted to pressure so as to get as much in a box as possible. That has been a source of great trouble to us in the works. To the small manufacturer, without large machinery and cutting knives, that is still a matter of great difficulty where it leads to the solidifying of the contents of the package. When he has to cut up a big block like that you can suppose that he sometimes gives one a very lurid idea of his difficulties.

I wonder whether we could have some way of keeping the sheets from sticking together in this way?

Passing to the question of milling, it is, of course, an important problem. It is not only that so much costly energy is absorbed, but if you are breaking down rubber and have not, perhaps, given it a certain amount of milling beforehand, the power absorbed in breaking the rubber down is producing a lot of heat, and if you have a somewhat catchy mixture you are liable to get very serious trouble. That is one of the reasons why we should endeavour if possible to get some plantation product which shall mill easily and still have good curing properties. In the old days the ease of milling was in some way related to the rubber's curing properties. Rubber which broke down easily was also a slow curing rubber. But some plantation rubber recently produced breaks down quite nicely, and even without accelerators cures fairly quickly. We have to look below the surface, and it is to some extent up to our plantation friends to get down to the causes of difficult milling properties and see how they are connected with constituents present in rubber or methods of preparation.

Of course, the question of packing may be made to cover the question of latex, as that is only another method of sending rubber to this country. Many of you know the various aspects of this subject. When one tries to export rubber in that form the difficulty is to keep it liquid. Some of the Americans have had trouble in that respect. The stuff is liquid at the beginning of the voyage, but if coagulation occurs it can be removed only with great difficulty at the other end. However, Dr. Hauser tells us that latex can be sent nowadays in a condition something like cheese, easily cut up with a knife, and not liable to coagulation. I am not sure, looking at our present methods of compounding, whether it is altogether a good thing to add the chemicals or drugs whilst the rubber is in latex form, but this is a question which can well be left for the future.

Mr. P. J. Burgess: I look upon this meeting to-day as really of very great importance, because it links up different branches of the industry, and, as some others have said, I think it should be the first of a series of meetings at which the various branches could put their problems before each other.

I have been asked to speak about packing. I remember that when we were in America eighteen months ago it was a subject we looked into very carefully, and we were favoured by an exhibition of the way cases were opened in the warehouses of the companies themselves. A sturdy man was called. He brought out an enormous axe, which reminded me for all the world of the ancient headman's axe, raised it over his shoulder, and smashed the case to bits. We thought it a very brutal process, and felt that the axe ought to have been applied in some other

direction. (Laughter.) The contents were turned out on the floor, and they said, "Now see what dust and dirt there is in this mass of rubber."

It has been suggested that the rubber should be wrapped in rubber sheets. I have lately seen a case prepared experimentally in this way and brought over to us. It may be the wrapping was not perfect in every corner, but we were astonished when we pulled it to pieces to find that the inner sheets inside had splinters on them. If we are to have rubber absolutely free from all impurity we should be in the position of a chemist who is asked to supply a "fine chemical." You can buy a 99 per cent. pure chemical at an ordinary price, but if you want a 99.9 per cent. pure chemical you have to pay an extremely different price. If we are asked to supply you with rubber guaranteed free from any mechanical impurity whatever, it means that the plantation people and the people engaged in its transport and delivery will have to take exceptional care at every stage of its movement from the plantation to the factory, and that cannot be done at the ordinary commercial price. I suggest that you must have two classes of first-quality rubber. There will be the ordinary commercial first-quality, which will be good for all your mechanical goods, probably for the outer covers of tyres; but if you want something guaranteed, rubber for inner tubes, or vulcanite for electrical purposes, then you will have to get a specially finished and packed article for which an extra price will have to be paid. You will have to treat it as a fine chemical, and not as an ordinary first-grade one.

We must be careful or we shall be in the position of people straining at gnats and prepared to swallow a chameleon—I mean camel. (Laughter.) I had chameleon in mind because of the colour variation of rubber. The colour means nothing to the grower. It is quite as easy to prepare rubber of a pale colour as of a duller shade. It does not follow that the fine-coloured is more suitable for your general purposes than the other material. Many plantations would be glad to get rid of the fetish of pale colour.

One speaker spoke of hydraulic pressure being used for pressing rubber into the packages. I never heard of it, I am inclined to think the sticking together of the sheets is due to the softening effect of the heat in the holds of vessels on the voyage and the weight of the rubber pressing on itself and sticking the warm sheets together. If it is wished to have sheets which can be easily separated, with the assent of the users it will be a simple thing to dust French chalk between the sheets. I think if manufacturers asked for it, this could easily be done.

I do not think there is anything else that I could usefully mention at the moment, and I will only thank you for your attendance and the Chairman for asking me to take part in the meeting. (Applause.)

Dr. Pickles: With reference to what Mr. Burgess has said on the subject of using pressure to get rubber into the cases, I think it is the practice in some parts.

Mr. Burgess: As to the factories of which I have knowledge I can say we do not press the sheets at all.

Major Eaton: On some estates in Malaya it is done.

Mr. Burgess: I am surprised to hear that. I was not aware of it.

Mr. Stockdale: And in Ceylon it is done to some extent.

Mr. Burgess: It would be, I take it, quite simple to have the sheets dusted over beforehand.

Professor Stafford Whitby: I express my great gratification at being present at this very timely conference.

It appears from the trend of the remarks that the subject which is perhaps prominent in our minds is that of the variation of plantation samples in the matter of milling properties and calendering properties, and it has occurred to me that quite possibly the course of events in that matter may be somewhat similar to what it has been in relation to variation in the rate of cure. In regard to that, the matter has been attacked and largely solved, partly on the plantations and partly in the factories: that is to say, the plantation is now producing a more uniform product, though not one entirely uniform, and, on the other hand, the factory, by the use of certain mixtures and accelerators, is doing its part to overcome the variability. I imagine it is not improbable that a similar course will be followed in this other matter; the problem being solved partly on the plantations and partly in the factory. The plantations are in a favourable position to investigate certain aspects of the question, and, on the other hand, the factories here are in a position to investigate the influence of certain small additions, and of compounding methods.

It has been mentioned that there are accelerators that soften rubber. Ira Williams has reported upon some investigations in this direction. Of course, if the action of the accelerator is prolonged scorching takes place. As to plasticity, I imagine it would be desirable to distinguish between the ease with which crude rubber breaks down on the mill and the plasticity of com-

pounded stock prepared from it. As to resistance to breaking down, undoubtedly the method mentioned by Dr. Schidrowitz appears to be straightforward and satisfactory. A good deal of rubber is tested in that way in the United States, and recently the Rubber Testing Committee of the American Chemical Society has tentatively proposed that breaking down tests should be carried out with a batch of 100 lb. of rubber on a 60-inch mill, to which an autographic Watt-meter it attached. I have also seen such tests carried out with a 600-gramme batch on a 12-inch mill. As regards the extrusion methods which have been mentioned, an apparatus has been suggested by Martzetti, or it might be possible to use a plastometer similar to Bingham's. And then again with regard to the question of the plasticity of the compounded stock, Williams has advocated a simple instrument which will repay investigation. It would be interesting to ascertain whether results obtained by such a penetrometer are parallel with those obtained by extrusion. The subject of the toughness of crude rubber and the plasticity of rubber stocks offers a very nice field of research and one to be tackled at both ends of the industry. We are in a position for research now, and there could be no more timely subject.

If we analyse this question of plasticity or resistance to breaking down, we have first to consider the influence of the mere mechanical work and also the question of heat. You must separate them. You may, for example, run your mills and calenders at a high temperature and not get such a good result as at a more moderate one. Then we have to consider the influence of small quantities of agents on the softening of the raw rubber, and again on the dispersion of pigments in the rubber. And it is quite possible the different agents may have different degrees of value when different pigments are in question; for we have to consider the question of the wetting of the pigments by the rubber, and different softening agents may be required for different pigments. We have got a subject here on which I feel sure considerable progress can be made, but it is obviously one on which a good deal of research will have to be carried out. I think Major Eaton rather suggested that variation in the rate of cure of raw rubber was really a thing of the past, but I believe I am giving the sense of the man in the factory when I say that this would be going too far, and that it is desirable that crude rubber should be more uniform in vulcanising behaviour. In this connection the only contribution I would make this afternoon is to suggest in the first place that a very much more clear-cut and universally recognised system of naming the various grades should be introduced. Brokers generally describe the lower-grade crepes by names that have little relation to the actual character—I mean to the origin—of the rubber. They use such designations as " roll brown crepe," " dark amber crepe," " gristly grey-

brown crepe," and so on, instead of names such as lump crepe, tree scrap, earth scrap, which give the origin of the rubber, and therefore some real indication of its probable quality. The Rubber Growers' Association would be performing a useful service if they could bring into general use standard names for the various lower grades. It would also be advisable to adopt letters as an abbreviated means of designating the various lower grades.

There are some arguments in favour of mixing all the lower-grade crepes into a compound crepe, but there are also arguments in favour of keeping them separate. As telling against the advisability of combining the crepes, there is the fact that the output of low grades from a single estate is not sufficient to make more than, say, two cases a day of a uniform product, and it is a question as to whether the product of such small batches of uniform rubber is worth the sacrifice of the comparatively high qualities of lump and tree scrap which their admixture with bark and earth scrap presumably involves. It is a question on which I should be very interested indeed to hear the opinion of Major Eaton and others.

The second point with regard to the question of uniformity to which I may draw attention is that something more than is now done can be done, I think, by the plantations in regard to their packing from this point of view. Let us say a plantation has a coagulating tank in which it coagulates 750 lbs. of rubber at a time—let us say five cases of rubber. Now, we do know absolutely definitely that these five cases, assuming that the rubber has been through the same treatment, contain absolutely uniform rubber which it would be very easy to sample. We know further it is probable that each lot of five cases prepared in the tank on different days from the same area will be comparatively uniform with the first, and that the whole shipment of that material would probably be uniform. Now, if the rubber were marked on the cases and on the shipping schedule so as to indicate that uniformity, you would assist manufacturers in getting uniform batches and in taking truly representative samples. I will not pursue that any further, Mr. Chairman, but I think something could be done with very little trouble by merely keeping the rubber from one coagulation (the smaller lots) and from one area in different coagulations (the larger lots) together, and marking the cases appropriately. (Applause.)

Mr. Sidney Morgan: I came here, Mr. Chairman, to learn and not to instruct. So many points have arisen on which criticism is invited that I feel able to deal with but a few in the brief time at my disposal. I will confine my remarks that I have to make, therefore, to these points which I consider to be of prac-

tical importance to the estates, as differentiated from the purely scientific aspect of the discussion.

In Mr. Porritt's paper a reference was made to a manufacturer's grievance. He mentioned a point which we on the estates likewise regard as a distinct grievance. It was a reference to the attention which is given to apparent trivialities in the evaluation of rubber, such as the presence of air-bubbles in sheets and the existence of a pale colour in crepe. These are matters with which the estates wish not to have to be concerned. We ourselves regard them as trivialities; but it must be remembered that we are dealing not with manufacturers, but with the market, and as long as the present system of market valuation continues to exist we must please the market and not the manufacturers. If the manufacturers as a body will tell us that the presence of bubbles in smoked sheet, or " rust " in sheet, or a very light colour in crepe, is of no value to them as a criterion of the quality of the rubber, they will find we shall welcome any definite statement of that sort. I merely mention this to show you the difficulties with which the actual producer of rubber has to contend. The criticism may appear to be rather severe, perhaps, but while much of the discussion to-day is doubtless of considerable benefit to the technical man, it does not seem to help the producer very much.

Mr. Porritt said in his paper that it would greatly surprise the producers of rubber who had packed fairly clean shipments if they could see that rubber as it is turned out on delivery to the manufacturers. We know that to be perfectly true, but it would also surprise manufacturers equally were they to know the trouble and care which the managers of estates give to the preparation and packing of their rubber. It seems to me that before we can meet on actual common ground we must have some other method of finding out exactly what is required or not required. I can assure the manufacturers that on most of the estates in the Federated Malay States, Sumatra, Java, and elsewhere, enormous trouble is taken in the preparation and packing of rubber, as much trouble as is possible considering the native labour which has to be employed, and it is really almost heart-breaking to the managers when they receive from their boards of directors letters criticising the quality of the rubber which reaches the market. It can be imagined what effect such letters have on a manager whose efforts have been nullified by damage done during shipment and the handling at the docks.

It all boils down to one point—what is to be the system of valuing rubber in the market? Of what possible use is it to the producer to be told by the manufacturer's technical adviser that small bubbles do not matter, or that a pale colour is not essential, when the raw product is to be valued in the market as if those

points actually did count as important? There would be no objection whatever, from the producers' point of view, to the suggestion that all rubber from any estate should be branded. There might be objections on the part of dealers. There again we come to a stone wall. As far as estates are concerned, there would be no difficulty whatever, and we would welcome any suggestion that could be put into practice with beneficial results.

Major Eaton, in his paper, paid particular attention to the question of the employment of wood for packing. You can be assured as manufacturers that we as producers are very concerned on this subject. If it were possible, we would like to do away with wooden cases, but at the present time it resolves itself into a question of economics. We have studied the matter at our end, and so far we have failed to find a cheaper method of packing which will satisfy the market. Baling of rubber has been mentioned. Estates have really tried in past years to meet what was thought to be the demand of the market, and we have witnesses in the room here to-day who could, if they would, speak as to the efforts they made years ago in the direction of baling, only to find that the rubber so baled was not marketable. Some time ago in Singapore I saw a new method which employed cases made of a fibre substance looking like strong cardboard. The substance was non-breakable and water-tight; cases were thrown from a height of 40 feet and proved to be unbreakable. They gave no splinters, and they were so tough that they would defy any dock hand to break them. I do not know what has become of this system of packing. The only objection I remember was that copper rivets were employed, which might come into contact with the rubber.

I had intended touching upon the shipment of latex, but it has been dealt with by several speakers, especially by Dr. Hauser, and I will leave it alone. I cannot close, however, without a tribute, as a former servant of the Rubber Growers' Association, to that body. No one can be better aware than I of the enormous amount of trouble and the large amount of money that has been expended by this Association. Many of its leaders are busy men in the rubber world, but they have thought it worth while to devote their time to the work, especially the work of their research organisation. If the efforts of the Association have not been successful to the fullest degree, that is entirely due to the deficiencies of some companies which have not become members, and whose attitude to those of us who work in the East, is neither helpful nor comprehensible. (Applause.)

Mr. Herbert Rogers: I have had the satisfaction of listening to discussions on rubber questions for the past twenty years, but I have not had the opportunity of attending, or reading an

account of a more interesting meeting than this one has been, and I can only surmise that the industry has reached a stage where gatherings of this kind have become necessary. There are organisations now which did not exist earlier to allow of conferences of this kind.

With regard to the question of packing, and other questions raised to-day, there is nothing new about them. We have heard the same questions raised long ago. We shall not make further progress until we have delivered to the factory packing cases which have not been opened and repacked, but marked clearly with the quality and the name of the estate that produced it.

In my concern we are old-fashioned people who still use a lot of uncultivated raw rubber, and we know what we have to deal with. We are so old-fashioned that we still wash crepe and smoked sheet. When we are unable to wash sufficient to keep the mills going, we occasionally open up cases of crepe or smoked sheet, and find it difficult to sort out a case which we dare put through the mills without washing.

With regard to the question of plasticity, we thought to solve that by mastication our latex under standard conditions before mixing in other ingredients. We find, however, we cannot handle it successfully in that way, as the variability is too great.

Another trouble which seems to have escaped attention is that of grit, which we find in smoked sheet and even best pale crepe. It appears to us to be very fine sand. In such things as football bladders, grit of this kind is a really serious trouble. If we can find it, as we do, in the die of a tubing machine or under the knife of a spreading machine, where it causes serious trouble to our workpeople and to the finished product, obviously it should be removed at its source from the liquid latex, and I submit this is a matter worthy of some attention.

Dr. H. P. Stevens: At this stage I will not detain you very long. We will deal first of all with the question of packing. Dr. Pickles made it quite clear that from the manufacturers' point of view it would not do to have baled rubber. It may be that to the large factory it would not matter, but it would be unsuitable for the small manufacturer. Therefore for rubber which has to be sold to the open market it is essential that some form of packing be adopted in which the sheets will not mass. All proposals for baling rubber may therefore be dismissed.

As regards the pressing of rubber into the cases. Rubber will of its own weight stick together somewhat, and unless a certain amount of pressure is exercised on the sheets in the case,

there will be an air space in the case and in transport the crepe will knock about inside the case and probably result in breakage of the case.

It was proposed several years ago to use French chalk to prevent massing, but the manufacturers would have none of it. From recent experience the manufacturers may have changed their opinion, and it would be of interest to know whether a majority of manufacturers would rather have French chalk to prevent the sheets sticking together or the occasional massing which takes place under the present system.

As to the milling capacity of the rubber, it is obvious from the remarks of Prof. Whitby that it is the manufacturers who have the means of choosing the best methods of testing. They alone are able to compare the results obtained in practice with tests with laboratory machines. In my experience I find the conditions to be quite different. On a full-sized machine, especially if it is motor-driven, it soon becomes apparent to the man in charge whether the rubber is behaving normally. We know well that certain types of rubber, blanket crepe, for instance, mill readily, and much plain crepe and sheet also, but at times abnormal material is met with.

Major Eaton has referred to my papers on sprayed rubber, and to the evidence I have brought forward that it ages better. I have shown that the improved ageing quality is due to the non-caoutchouc constituents of such sprayed rubber produced with greater rate of vulcanisation.

In this connection references were made to the Hopkinson process. I might refer incidentally to the fact that although the process under this name has been carried out on a large scale in the East, it was not the first process devised for producing sprayed rubber. I believe the Hopkinson process dates from about 1920, whereas Krause produced sprayed rubber in 1914 with a machine which I believe is practically identical. (Applause.)

Mr. Savage: As a manufacturer, I want to deal with one particular point, namely, the question of packing. Much trouble would be avoided if cases were constructed so that they could be easily opened. Where hoop iron bands are used, they are difficult to remove. Nails driven home cannot be withdrawn. The usual method of opening cases by smashing them with a hatchet is destructive, and also causes much dust and splinters, some of which get into the rubber. More careful methods are tedious and costly. My experience is confirmed by a large American user in the same line of business.

The use of compressed paper washers under the nail heads of the lid would permit of withdrawal by an ordinary tool. If producers would supply cases with one face easily removable, they would be welcome.

We get three general classes of cases, namely, plywood, ordinary white wood, and a kind of mahogany, which is usually planed. The first is clean, but difficult to open without smashing; the second produces a lot of dust and splinters; the last is clean, and is preferable to the other two, although the cases are heavy.

Some packages of rubber arrive with two sheets wrapped round at right angles, thus covering the ends of the layers. This is an appreciable advantage, as it lessens, although not entirely prevents, the risk of splinters getting in between the layers. Some other form of wrapper, such as stout paper, seems desirable, but one hesitates to make a definite suggestion without a knowledge of the producers' conditions. It is, however, a pity that preference should have to be given to a particular brand of rubber merely for the sake of its packing.

It would be advantageous if cases could be abandoned in favour of a collapsible or flexible packing, mainly because of the space taken up by empty cases, which is often an important factor, and the difficulty of disposing of empties. I have tried rubber packed in jute sacking, but it failed disastrously because of the fibres adhering to the rubber and the dust that penetrated the sacking. Reference was made in one of the papers to a sizing material applied to the sacking as supplied to large American users. This may stick the fibres down to some extent, but is not likely to be good enough for manufacturers of fine goods or for electrical purposes. A clean, smooth non-perforated wrapper, such as a strong paper, inside the jute sacking would appear to offer a solution, provided that the inner layer did not adhere to the rubber.

Dr. Butler: I am afraid I have no excuse for intervening in the discussion. Industries like this have recognised for many years the need for applying research methods on the manufacturing side, but I think it is not so long ago that they began to realise the responsibilities—or perhaps I should say the profitable field—that there is for the application of research at the other end, on the producing side of the plantation industries. I am here in a way as representing the Government of India, and it is right that I should say something of the experience we have had in India with regard to that matter. One of the oldest plantation industries to start a scientific department of its own was the Indian tea industry. A research station was

started, supported by the industry itself, except for a small Government subsidy of, at present, about one-fortieth of its expenditure. This Government grant gives the advantage that the work done by the industry is made use of by bodies which are not members of the particular association employing the research staff. That is, I believe, a distinct advantage to the industry as a whole, especially in such matters as plant disease control. Another system followed in another part of India was that a member of the Agricultural Department was seconded to serve with the industry, and in another case the industry sent one of their men to work with us. There was actual permanent co-operation in each case with the members of the Government research staffs. That something of that sort is advisable I have no doubt.

About a fortnight ago we had a conference primarily of the official mycologists of the Empire on plant diseases, and one subject down for discussion was the encouragement of industrial enterprise in the control of plant diseases, and the mycologist of the Indian Tea Association's Department gave us some remarkable figures. He ended up by saying if it had not been for the assistance of the Government Research Department he could not have done anything. I would like to say that on the side of the Government Research Institute we could not in any way have done for the tea industry what their own research department did. In our particular branch the treatment of plant diseases, the particular side of it that the industry can tackle far better than the Government can, is the control of the insect and fungous pests on their estates; and we admit that we could not have done as much for the tea industry in India as the industry itself has done. The co-operation was very close. The members of the Government staff toured in the tea districts to see what work was being done, and the industry's mycologist came and worked at our headquarters periodically. We decided at the Conference a fortnight ago that it was up to us as official Government mycologists to do all we could to encourage the setting up of industrial enterprise in the matter of controlling plant diseases. One of the most hopeful features in the application of scientific research to these industries is that it is not being left entirely to Government Departments to handle these things, but that the industries themselves are taking a very definite part in the matter, and are setting up departments of their own in co-operation with the Government Research Institutes. (Applause.)

Mr. W. Smith: Mr. Chairman, I think it is a mistake to arrange a list of speakers instead of throwing the discussion open. Some who may be inclined to speak are obliged to leave early, like my friend Mr. Bayles.

I think the problem this meeting has to face is one which has been waited for a long time, so I do not agree with Dr. Schidrowitz when he says, "Planters and manufacturers have been anxious to keep away from each other." I think they have been anxious to get together. The planter needs to meet the manufacturer to know just what he wants, and the same is true of the other side. If the two can meet in order to deal with their problems they would always be glad to get together. So the object of this Conference is very important.

To come to variations in rubber, I feel it is rather old-fashioned to dwell too long on variation in the rate of cure. What one would like the rubber growers to concentrate upon is to attain uniformity in the quality of the rubber. One way in which this will be helped is by the new arrangement whereby the brokers will open only 5 per cent. or 10 per cent. of the cases that arrive in the docks. If this be done methodically, I think the estates can be trusted, and I can imagine manufacturers ultimately asking for rubber produced by certain estates. This will result in the elimination of estates that are not taking sufficient care with their rubber.

In some instances the manufacturer finds rubber which comes to him in such a condition that it is impossible to pull it apart. Some varieties of thin pale crepe are easily pulled apart, while others are exceedingly difficult to deal with; in some cases the rubber has been packed for a very long time. We also have smoked sheet rubber which is almost a drab colour in the centre of the sheets, due to being packed before the rubber was properly dried. We must not put all the blame on the shoulders of the plantation officers. I feel quite confident that a lot of trouble arises from third parties—I refer to the brokerage system. I have seen the trouble at the docks, and when I saw the methods adopted for handling rubber I knew it must be staggering for some complaints to go back to the estates. On the other hand, I have seen a lot of rubber arrive from the East Indies and Malaya packed in venesta cases, and I must say the rubber was almost perfect. It was wrapped in sheets of the same rubber, with half sheets at the corners tightly pressed together, and there was nothing to complain about. On the other hand, I confirm the remarks I heard just now about different types of rubber being found in one case, but it is not correct to put such complaints against the estate, as we do not think estate people are altogether responsible for such things as that.

In conclusion, I think the estate officers should not concentrate too much on rate of cure, as in most cases vulcanisation can be controlled by judicious use of accelerators. I hope if

this meeting produces anything it will produce something in the way of uniformity in the quality of rubber, and give the estates an opportunity of showing what they can do.

Dr. T. J. Drakeley: The question of co-operation in research schemes, which has been raised by the speakers this afternoon, is to me a point of vital importance. Research may be divided into two classes—industrial research and academic research; the former class is concerned primarily with the investigations of problems of immediate value, whereas the second is devoted to the solution of problems of no apparent commercial value.

Although the distinction is convenient in our case, it is essential to observe that the classification is false, since it is dependent upon merely the vague factor—time. At any moment the academic research may become of industrial value, and thus effectively falsify the classification mentioned.

However, there exists at the Northern Polytechnic Rubber School all the necessary apparatus for the manufacture and testing of rubber products. In addition, during the past two years, fifty men have secured degrees of the University, and many of them are anxious to proceed to higher degrees by research. So long, therefore, as the research undertaken by the student shall be an educational training, the funds necessary for the conduct of the work will be forthcoming from the educational authorities. Of that I am quite confident. In this connection it is obvious that academic research will be our main undertaking.

The important point to be remembered is that at the Northern Polytechnic Rubber School, the men, plant and funds are available.

The problems, even of academic interest, are so numerous that duplication of work should be avoided. Co-operation, therefore, is essential, and I shall offer a warm welcome to any schemes in which we can take an active part.

With regard to the references made to the possible use of French chalk to prevent the rubber sheets adhering, a few experiments recently carried out in the Rubber School showed that the necessary amount of French chalk is so infinitesimal that I should anticipate no difficulty in the subsequent use of the rubber in the factory. It is proposed to continue this investigation and to report details later.

Finally, I should like to express my appreciation of the invitation to be present at the conference this afternoon.

The Chairman: Well, gentlemen, I have listened with the greatest possible interest to the discussion that has taken place. A great deal of it I could reply to in an amateurish way, but I am not going to attempt that. What I do promise you is this—that so far as it lies in the power of the Rubber Growers' Association to bring about that closer co-ordination of effort in research work throughout the rubber industry we are going to do our very best to promote that. (Hear, hear.) I landed myself with the chairmanship of our own Research Committee some years ago by agitating for the co-ordination of the research work we are doing in the East; and while we have in Ceylon a research organisation where Government and the industry co-operate, we have not yet attained to that happy position in Malaya, though before long we hope to have satisfactory co-ordination there.

The manufacturers some years ago, I think it would be true to say, had no means of coming together amongst themselves in the way that exists in the Association Mr. Porritt represents. That is a great step forward. It seems to me as simple as A, B, C, that the Association that has to deal with the problems of the manufacturers should sift out of those problems the ones that must be passed on to the producers of rubber to be dealt with by them; and by a very simple co-ordination of effort I am sure we shall travel faster in the future than we have in the past. (Applause.)

It has been suggested that we should have regular meetings of this nature. I am of the opinion that if they are to be successful we must have an agenda, and the members of the two associations must see that all the pressing points are put down on paper, so that those who will attend will know precisely what subjects are to be discussed, and we will stick to the one point till it is thrashed out. (Hear, hear.) This gathering to-day has been entirely of an experimental character, and while I appreciate fully what Mr. Smith has said, I think one could not have conducted this meeting in any other way than I have endeavoured to do. I do not know whether Major Eaton would like to say anything on the points raised, but I am clear on this—that the manufacturers must sort their own minds a bit. For certain purposes you require your rubber to be free from certain blemishes and defects, but these defects and blemishes may be immaterial for other purposes, and we get off the rails if we assume that all rubber has to be up to the tests you wish to apply for diverse manufacturing processes. I was in the United States last spring, and went through factories where they put through 20,000 tons of rubber in a year, all for tyres and tubes. What they can use for outer covers may be no use for tubes.

Another point to remind you of is that not more than a half of the rubber produced in the East is produced on what you may call European-owned estates. You have Chinese estates and small native holdings. The small native holdings represent one-third of the bulk turned out. It is produced in primitive fashion, and much of it is milled in Singapore, and I am told it is useful for certain purposes, it is softer than ordinary rubber and so on. If we could weigh up the requirements of the industry in tons we should find that so much was required for outer covers; and you say, "We don't mind if that is pressed. That can be shipped over in bales quite easily." The American manufacturers are clamouring for rubber in bales for certain purposes. You say, "We want rubber that won't stick together." French chalk, I gather, is a possible medium for rubber in that form. You will have to give us a fair idea of the percentage of importance we have got to attach to the factors brought to our notice to-day and on previous occasions. That cannot be done on an occasion like this. It has got to be done in committee, and it is quite clear that in the course of the next few months we will have to see that the two associations, through their officials, get to grips with the whole problem, and that a proper questionnaire is drawn up with a view to putting this matter on a strictly business footing.

I thank you for making the meeting to-day a success. Arrangements will be made for a report of the proceedings to be published in due course. In years to come I think we shall look back to this conference with gratification, because I believe it will help to put us on the right road to rapid progress. (Applause.)

The meeting concluded with votes of thanks to the Chairman and to those gentlemen who had read papers, both proposals being carried with acclamation.

Memorandum.—In connection with the problems incidental to the marketing of rubber, it may perhaps be of interest to refer to the practice followed in the case of another well-known product, dealt with in the following communication received from Mr. E. M. Hawkins, F.I.C. :—

"For over 100 years hops have had to be marked with the place of growth, etc., but the present Act in force is 29 Vict., Cap. 36, which repeals earlier Acts.

"Under this Act every bag of hops must be marked with the name of grower, parish, county, year of growth, progressive

number of bag, and gross weight. There are penalties for not marking, false description, rebagging foreign hops in marked bags, altering marks, etc.

" And I know that the Act is carried out. The whole of the trade, with the exception of a few private sales, brewers growing their own hops, etc., is in the hands of factors, so that although the factor is not done away with (corresponding to the broker in the rubber trade) every buyer knows where and when his hops were produced."

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